

REMARKS

The Official Action mailed July 28, 2004, has been received and its contents carefully noted. Filed concurrently herewith is a *Request for One Month Extension of Time*, which extends the shortened statutory period for response to November 28, 2004. Accordingly, the Applicants respectfully submit that this response is being timely filed.

The Applicants note with appreciation the consideration of the Information Disclosure Statements filed on October 14, 1999, April 9, 2001, December 12, 2001, March 21, 2002, September 20, 2002, September 30, 2003, and April 30, 2004. A further Information Disclosure Statement is filed herewith and review and consideration of this IDS is requested.

Claims 15-24, 28, 30-115 and 123-178 were pending in the present application prior to the above amendment. Independent claims 28, 30, 31, 34 and 35 and dependent claims 46, 53, 60, 67 and 74 have been amended, and claims 42-45 have been canceled. Accordingly, claims 15-24, 28, 30-41, 46-115 and 123-178 are now pending in the present application, of which claims 15, 17, 20, 22, 28 and 30-35 are independent. For the reasons set forth in detail below, all claims are believed to be in condition for allowance. Favorable reconsideration is requested.

Independent claim 28 has been amended to more clearly distinguish over the cited prior art of record. As amended, claim 28 recites heat treatment in a reducing atmosphere and further recites that a concentration of oxygen or an oxide compound is not higher than 10 ppm. Independent claims 30, 31, 34 and 35 have been amended to clarify the formation of the claimed oxide and heating to reduce the oxide. Dependent claims 46, 53, 60, 67 and 74 have been amended to merely change "inactive" to "inert" to more closely confirm to the written specification. None of the amendments add new matter and favorable consideration is requested in view of the remarks that follow.

The present invention is directed to a method of fabricating a semiconductor device. The independent claims recite various steps in the fabrication of the device and include a heat treatment in a reducing atmosphere (claims 15, 17, 20, 22, 28, 32 and

33) or heat treatment in an atmosphere that reduces an oxide formed on a surface of a semiconductor film (claims 30, 31, 34 and 35). The claims further recite that the heat treatment in the reducing atmosphere has the effect of leveling the semiconductor film by removing asperities. The semiconductor film can be used, for example, as an active layer of a thin film transistor, or TFT. These asperities may be formed on the surface of a crystalline semiconductor film when the film is melted and a volume expansion occurs. Since this surface becomes an interface between the semiconductor film and the gate insulating film, these asperities greatly affect the performance characteristics of the TFT unless they are flattened. Also, the reduction of a natural oxidation film is advantageous since it assists in the flattening process.

The Applicants appreciate Examiner Diaz's time in conducting a personal interview in the subject application on November 16, 2004. During the interview, the Applicants discussed the outstanding rejections based on JP 10-135469 and it was agreed that this '469 reference appears to teach a second heat treatment in an oxidizing atmosphere contrary to the claimed reducing atmosphere. The Applicants' arguments are set forth below and it was agreed that these arguments will be further considered in a subsequent Official Action in response thereto. It was also noted that U.S. Patent 6,365,933 is in the family of JP10-135469 and is submitted in an Information Disclosure Statement herewith for consideration of the Examiner.

Paragraph 3 of the Official Action rejects claims 22 and 23 as anticipated by JP 10-135469 to Yamazaki. The Applicants respectfully traverse the rejection because the Official Action has not established an anticipation rejection.

As stated in MPEP § 2131, to establish an anticipation rejection, each and every element as set forth in the claim must be described either expressly or inherently in a single prior art reference. Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

The Official Action asserts in part that Yamazaki '469 discloses heat treatment in a reducing atmosphere and cites paragraphs [0049] and [0052] to support this

argument. In the *Response to Arguments*, the Official Action asserts that paragraph [0049] explicitly teaches the required reducing atmosphere. For the reasons that follow, the Applicant respectfully disagrees and requests favorable reconsideration.

First, as previously asserted in the response filed by *Certificate of Mailing* on May 30, 2003, and supported by a technical dictionary definition attached thereto, it is submitted that a "reducing atmosphere" is "an atmosphere of hydrogen (or other substance that readily provides electrons) surrounding a chemical reaction or physical device; the effect is the opposite to that of an oxidizing atmosphere." Thus, a reducing atmosphere is effectively the opposite of an oxidizing atmosphere.

As stressed during the interview, it is respectfully submitted that Yamazaki '469 discloses an oxidizing atmosphere, not a reducing atmosphere as claimed in the subject application. Furthermore, U.S. Patent 6,365,933, which includes substantially similar disclosure as Yamazaki '469, provides further support that Yamazaki '469 is directed to an oxidizing atmosphere.

The Official Action asserts that paragraph [0049] of Yamazaki '469 explicitly teaches the required reducing atmosphere. But, this paragraph merely discloses an atmosphere containing a halogen, and paragraph [0052] makes clear that this atmosphere is an oxygen atmosphere having 0.5-10 volume % HCl. A similar disclosure is found in Yamazaki '933 at column 6, lines 55-58. Furthermore, paragraph [0060] of Yamazaki '469 and column 7, lines 50+ of Yamazaki '933 make clear that this atmosphere is an oxidizing atmosphere, which as noted above has the opposite effect to that of the claimed reducing atmosphere. Also, finally, paragraph [0063] of Yamazaki '469 and column 8, lines 7+ of Yamazaki '933 make clear that in the process disclosed therein an oxidation reaction occurs and a thermal oxidation film is formed. Thus, it is clear that the atmosphere of Yamazaki '469 and of the family of Yamazaki '933 is oxidizing, not reducing as claimed. Also, since these references disclose that an oxidation film is formed, they clearly teach away from the claimed limitation that an oxide formed on the surface of the semiconductor film is reduced, or removed.

Since Yamazaki '469 does not teach all the elements of the independent claims, either explicitly or inherently, an anticipation rejection cannot be maintained. Accordingly, reconsideration and withdrawal of the rejections under 35 U.S.C. § 102 are in order and respectfully requested.

Paragraph 6 of the Official Action rejects claims 15-21, 24, 28, 30-115 and 123-178 as obvious based on the combination of JP 10-135469 to Yamazaki et al. and U.S. Patent No. 5,869,387 to Sato et al. The Applicants respectfully traverse the rejection because the Official Action has not made a *prima facie* case of obviousness.

As stated in MPEP §§ 2142-2143.01, to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. "The test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art." In re Kotzab, 217 F.3d 1365, 1370, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000). See also In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); In re Jones, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

The prior art, either alone or in combination, does not teach or suggest all the features of the independent claims. It is respectfully submitted that Sato does nothing to overcome the deficiencies noted above with respect to Yamazaki '469. While Sato may generally disclose a heat treatment in a reducing atmosphere to reduce asperities

on a surface of a semiconductor film, it is respectfully submitted that there has been an insufficient showing that one of skill in the art would have been motivated to combine Yamazaki '469 and Sato to achieve the present invention. The rejected claims suggest that a heat treatment in a reducing atmosphere is conducted in a specific step of a manufacturing method of a semiconductor device, in order to flatten a surface of a crystalline semiconductor film which becomes an active layer of a TFT or to reduce a natural oxidation film on the surface of the crystalline semiconductor film. In the crystallization step, asperities (ridges) are formed on a surface of a crystalline semiconductor film since a semiconductor film is once melted and a volume expansion thereof occurs. The characteristic of a TFT is greatly affected by the asperities since the surface of the crystalline semiconductor film having the asperities becomes an interface between a gate insulating film and the crystalline semiconductor film. Therefore, flattening the surface of the crystalline semiconductor film is very effective for the characteristic of a TFT in a semiconductor device. Also, the reduction of a natural oxidation film has an advantage since a number of silicon atoms with high energy are produced and the flattening effect is consequently raised. Sato et al. merely disclose the flattening and smoothing of a monocrystal substrate. Sato et al. suggest neither a reason nor a necessity for flattening a surface of a crystalline semiconductor film or reducing a natural oxidation film in a specific step of a method of manufacturing a semiconductor device, and therefore, there is no motivation or suggestion for applying the flattening step of Sato et al. to the manufacturing steps of Yamazaki et al.

Since Yamazaki '469 and Sato do not teach or suggest all the claim limitations, a *prima facie* case of obviousness cannot be maintained. Accordingly, reconsideration and withdrawal of the rejections under 35 U.S.C. § 103(a) are in order and respectfully requested.

Paragraph 8 of the Official Action rejects claims 15-24, 28, 30-115 and 123-178 under the doctrine of obviousness-type double patenting over claims 1-66 U.S. Patent No. 6,559,036 to Ohtani. In response to this rejection, a *Terminal Disclaimer* is

submitted herewith. Upon filing of this *Terminal Disclaimer*, the claims of the present application are now believed to be in condition for allowance. Reconsideration and withdrawal of the obviousness-type double patenting rejections are requested.

Paragraph 9 of the Official Action rejects claims 15, 16, 20, 21, 28, 30-115 and 123-178 under the doctrine of obviousness-type double patenting over claims 1-77 of copending U.S. Application No. 10/081,767 to Sato et al. In response, the Applicants respectfully request that the double patenting rejections be held in abeyance until an indication of allowable subject matter is made in either the present application or the copending application. At such time, the Applicants will respond to any remaining double patenting rejections.

Should the Examiner believe that anything further would be desirable to place this application in better condition for allowance, the Examiner is invited to contact the Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,



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